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Nagahata et al.

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(54) **ROTARY COMPRESSOR AND REFRIGERATION CYCLE APPARATUS**

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F25B 41/31	(2021.01)
F25B 37/00	(2006.01)

(52) **U.S. Cl.**

CPC ***F25B 31/026*** (2013.01); ***F25B 37/00*** (2013.01); ***F25B 41/31*** (2021.01); *F25B 2400/07* (2013.01)

(58) **Field of Classification Search**

CPC F25B 2400/07; F25B 31/026; F25B 37/00; F25B 41/31; F25B 13/00; F04C 29/0021; F04C 2240/40; F04C 2240/80; F04C 18/3564; F04C 23/008

See application file for complete search history.

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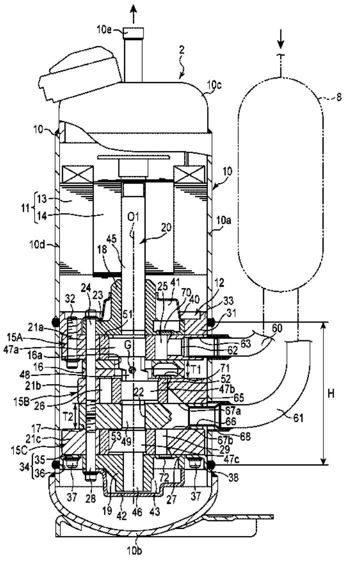
(57) **ABSTRACT**

According to one embodiment, a rotary compressor includes a compression mechanism unit and an electric motor. The compression mechanism unit includes a first bearing, a second bearing, first to third refrigerant compression units, a second intermediate partitioning panel, and a rotation shaft. The compression mechanism unit is fixed to the sealed container by a pair of fixing units which are provided at two locations spaced apart from each other in the axial direction of the rotation shaft, and the center of gravity of a structure comprising the compression mechanism unit and the rotor of the electric motor is positioned between the pair of fixing units.

7 Claims, 11 Drawing Sheets



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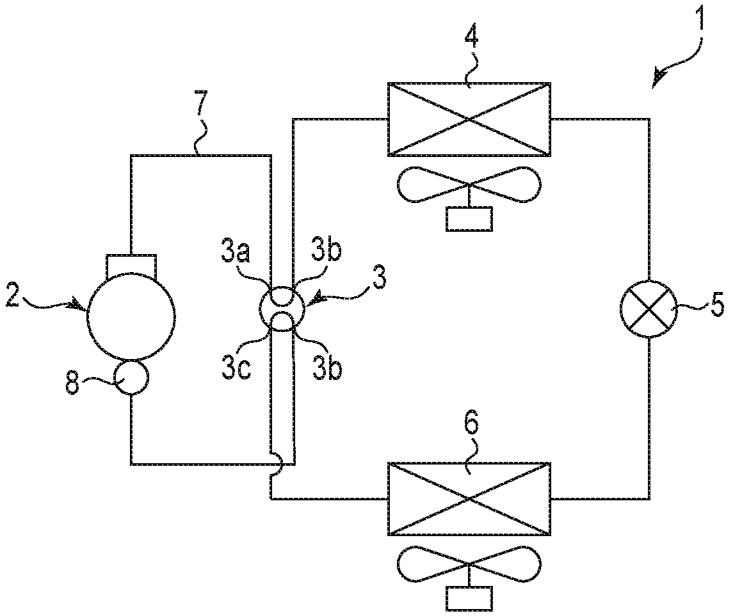
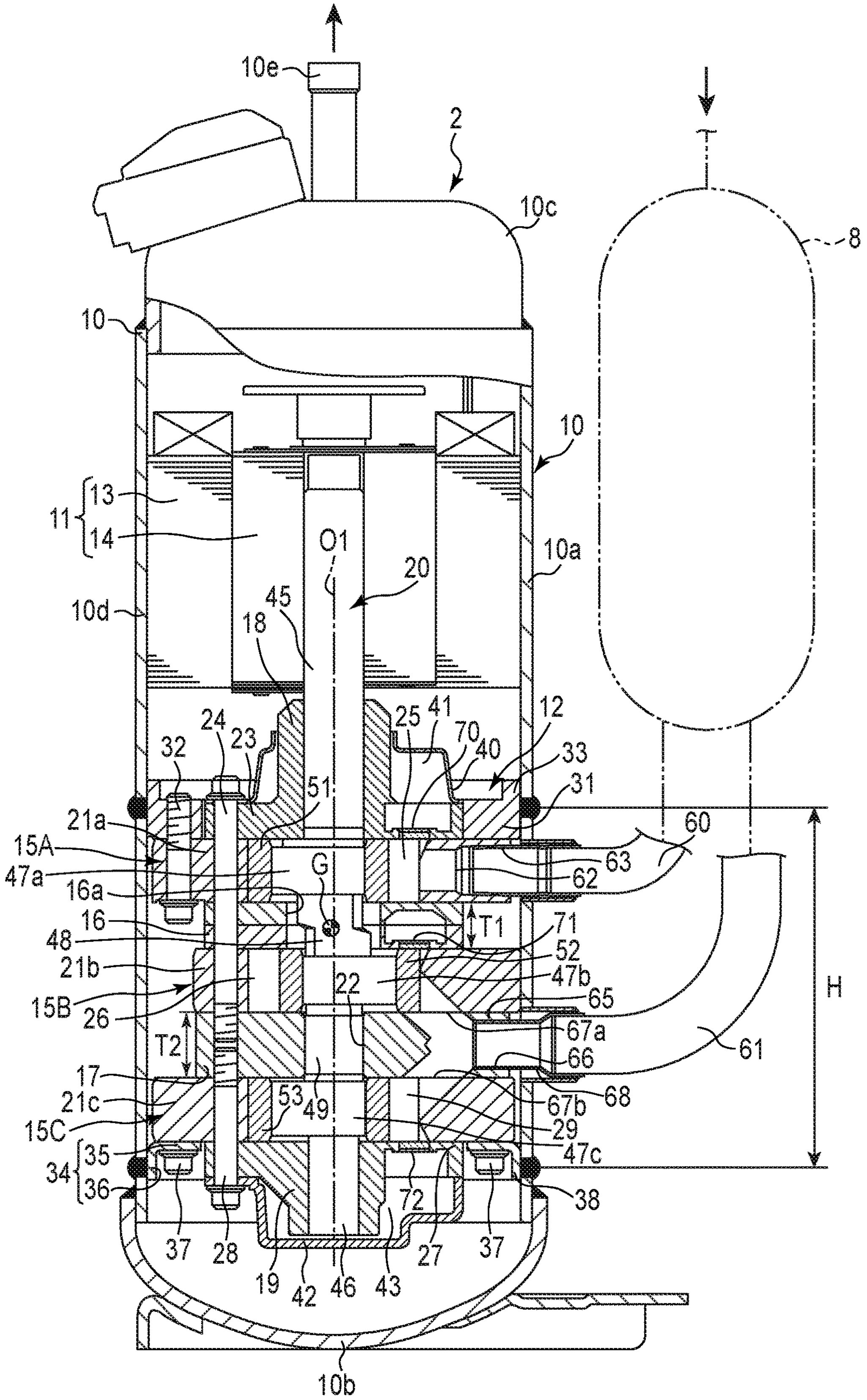


FIG. 1


10e
2
10c
8
10
10
11
13
14
O1
20
10a
10d
45
18
24
23
25
41
70
12
40
33
31
32
21a
51
60
15A
47a
G
63
62
16a
16
T1
71
48
52
21b
22
47b
15B
26
65
67a
T2
66
61
H
17
21c
53
49
68
67b
15C
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47c
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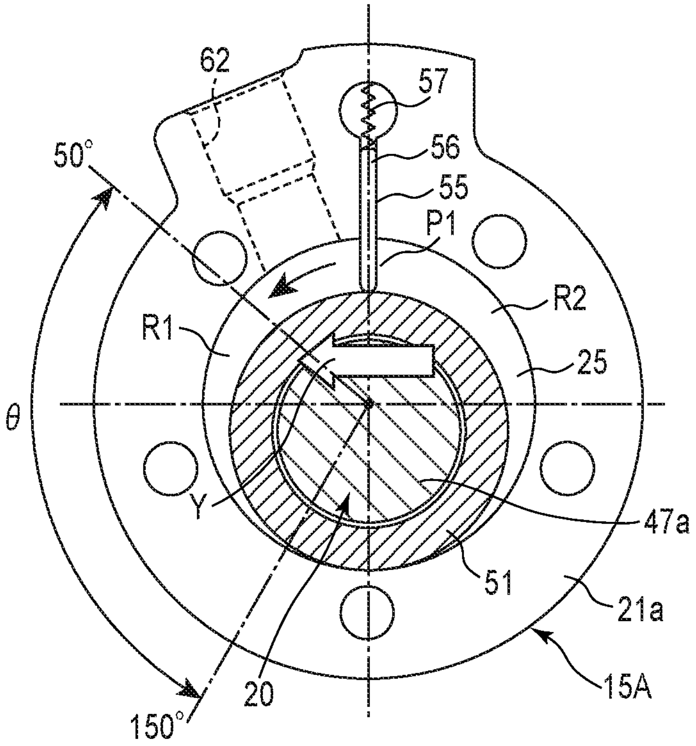
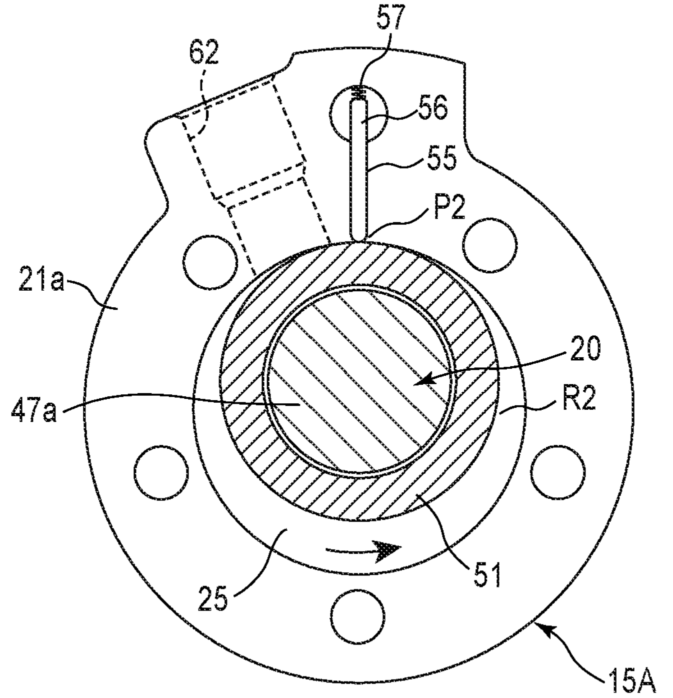
34
36
72
38
37
28
27
37
19
42
46
43
10b

F I G. 2


62
57
56
55
50°
P1
R2
R1
25
θ
Y
47a
51
21a
15A
20
150°

F I G. 3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P2
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20
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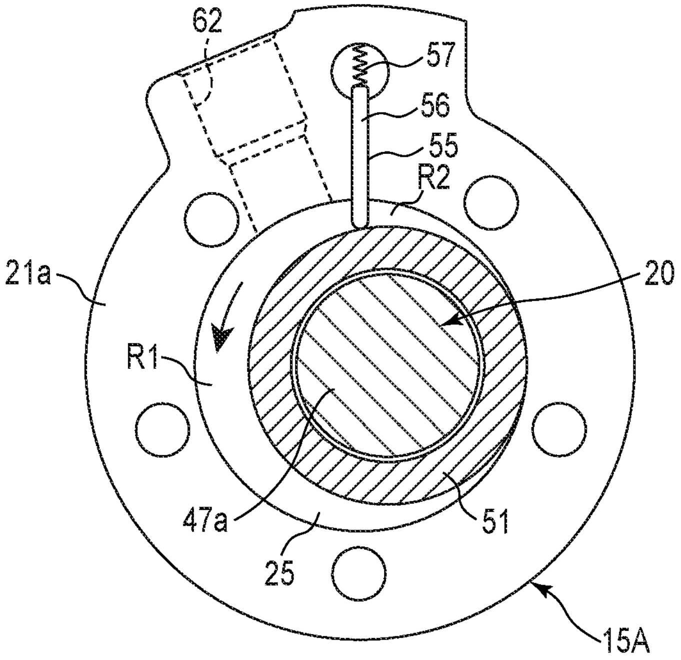
25
51
15A

F I G. 4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R2
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21a
R1
47a
51
25
15A

FIG. 5

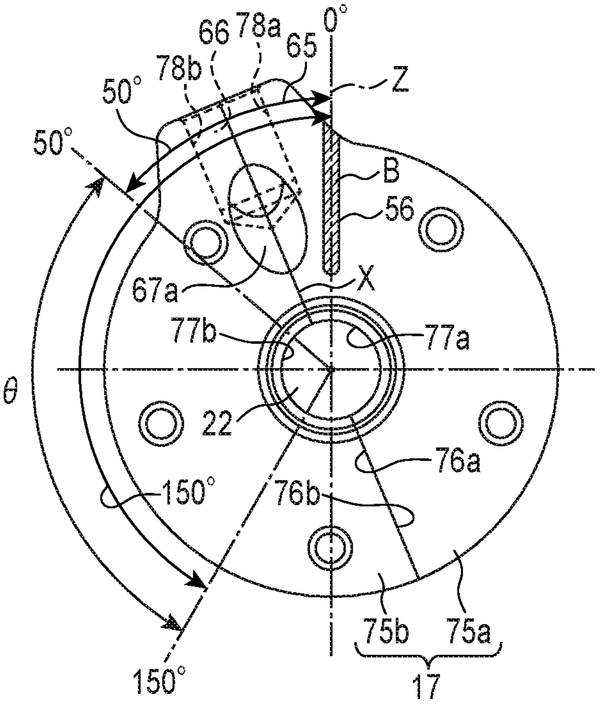
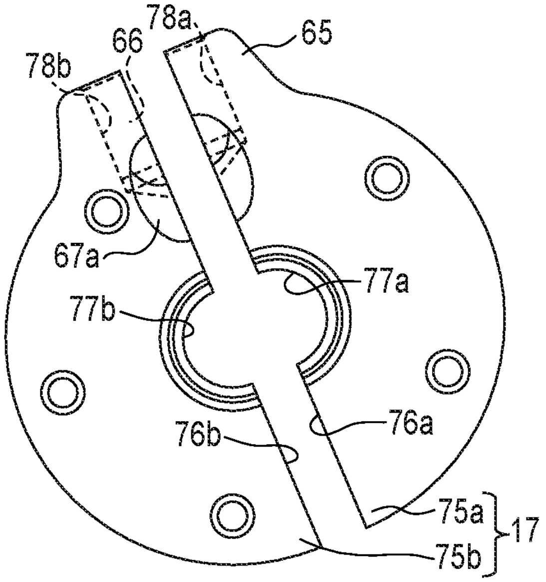

66
78a
0°
78b
65
Z
50°
50°
B
56
67a
X
77b
77a
θ
22
76a
150°
76b
75b
75a
17
150°

FIG. 6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66
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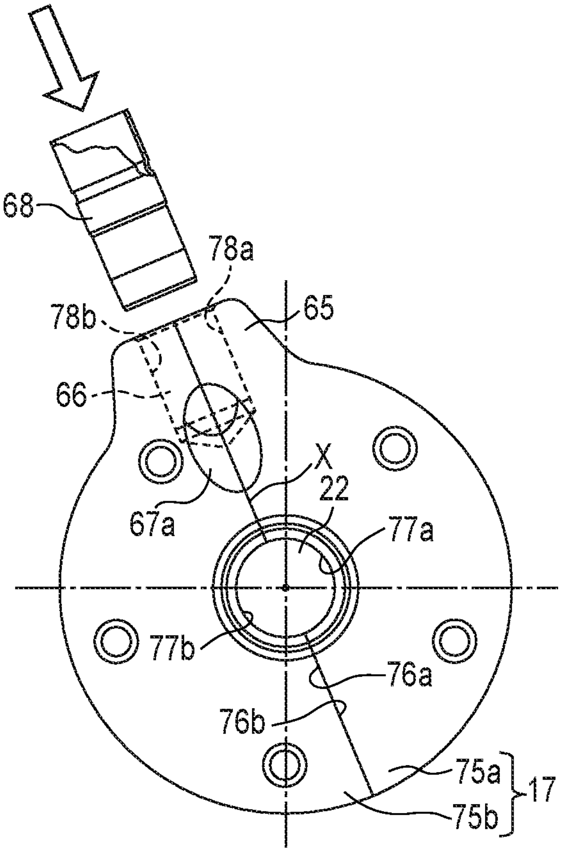
78b
67a
77a
77b
76a
76b
75a
17
75b

F I G. 7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78a
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66
X
22
67a
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77b
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76b
75a
17
75b

F I G. 8

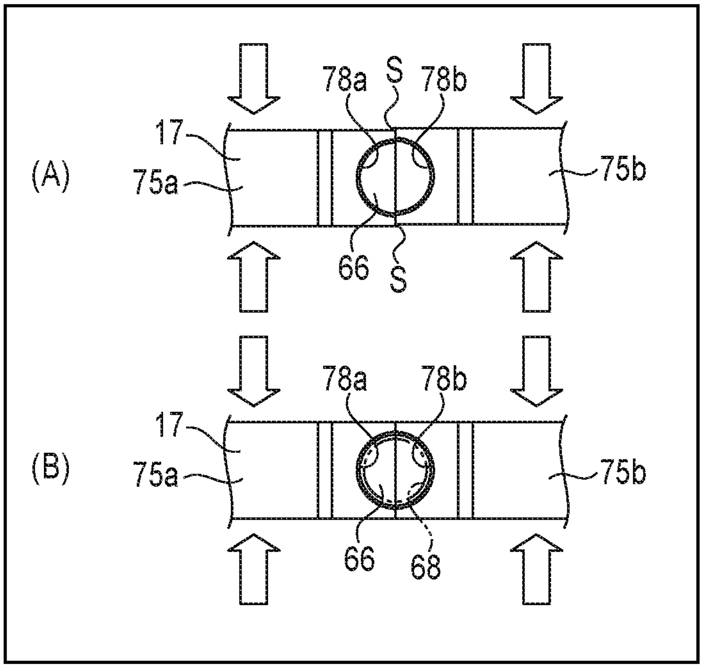


FIG. 9

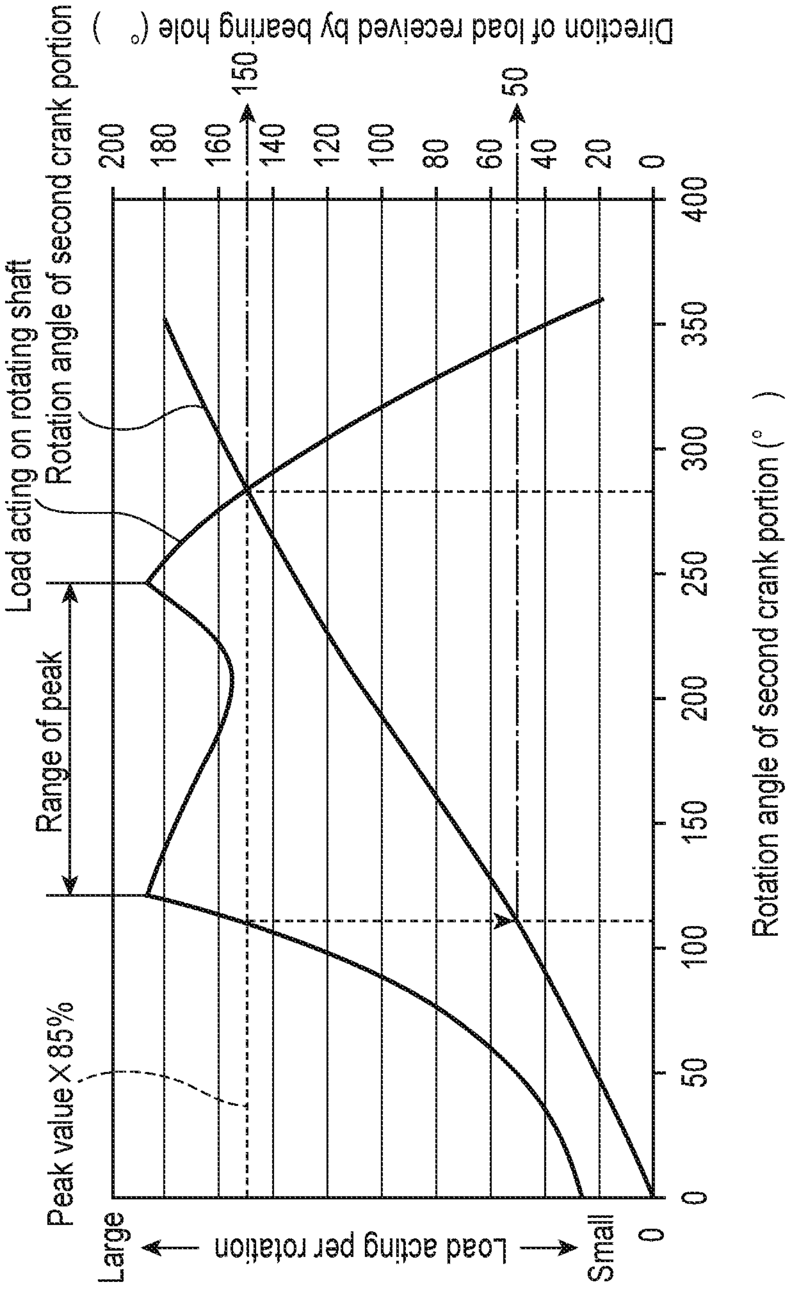
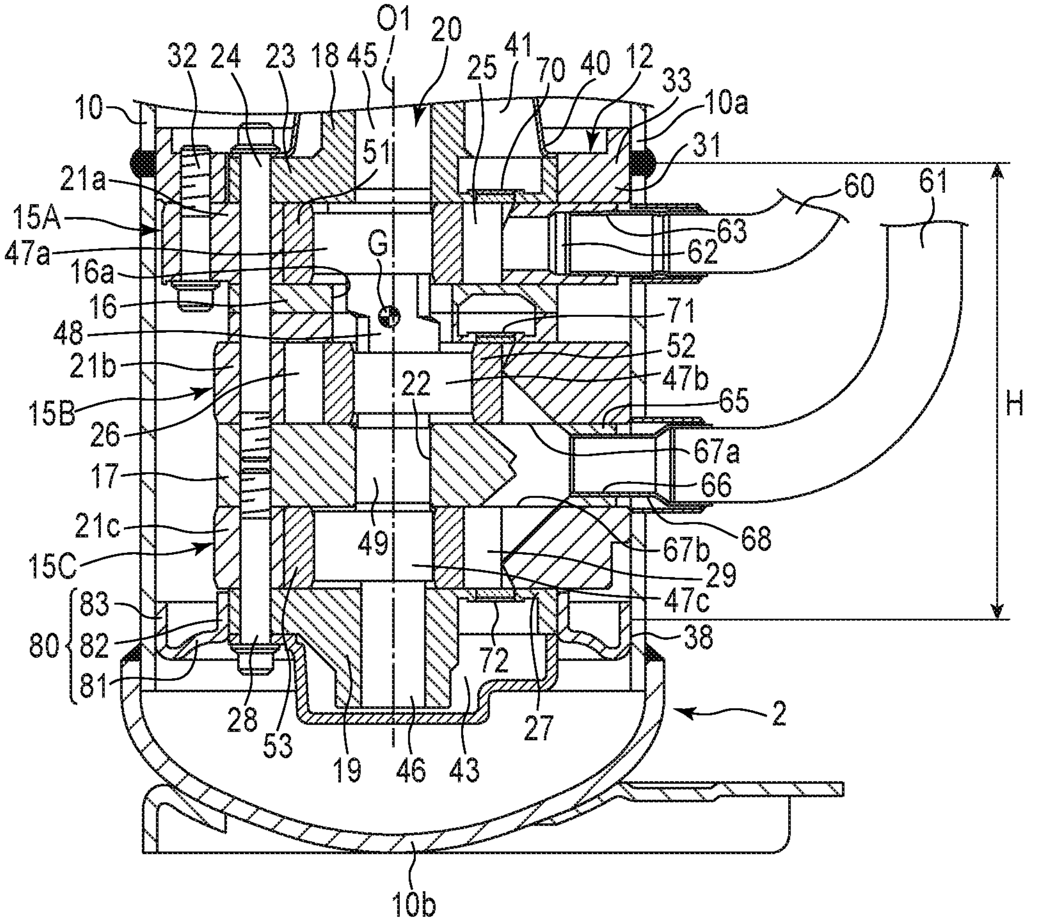

Direction of load received by bearing hole (°)
200
180
160
150
140
120
100
80
60
50
40
20
0
Load acting on rotating shaft
Rotation angle of second crank portion
Range of peak
Peak value×85%
Large
Load acting per rotation
Small
0
0
50
100
150
200
250
300
350
400
Rotation angle of second crank portion (°)

FIG. 10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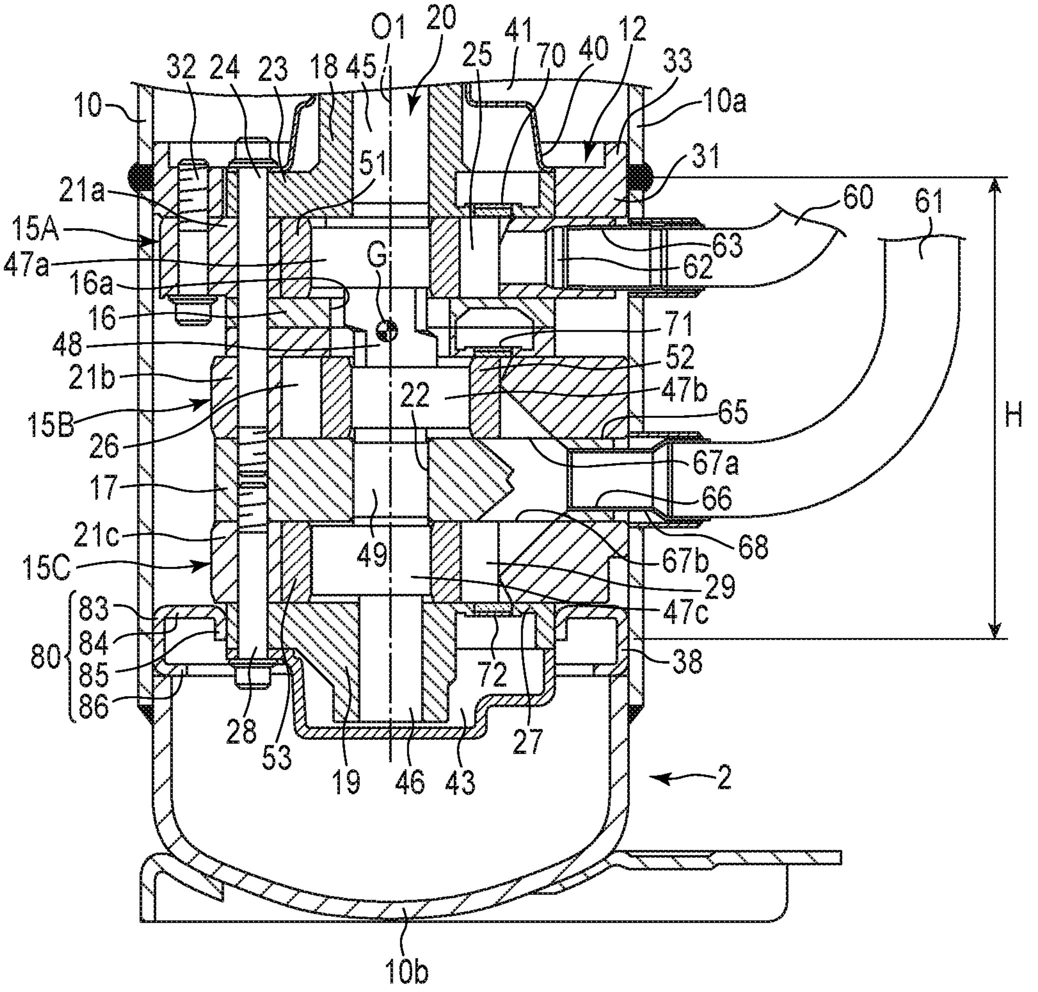
15A
G
63
47a
62
16a
16
71
48
52
21b
47b
22
H
65
15B
26
67a
17
49
66
21c
68
67b
15C
29
47c
83
80
82
81
72
38
28
53
19
46
43
27
2
10b

F I G. 11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15A
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47a
G
62
16a
16
71
48
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21b
47b
65
15B
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22
H
67a
17
66
21c
49
68
67b
15C
29
83
47c
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80
85
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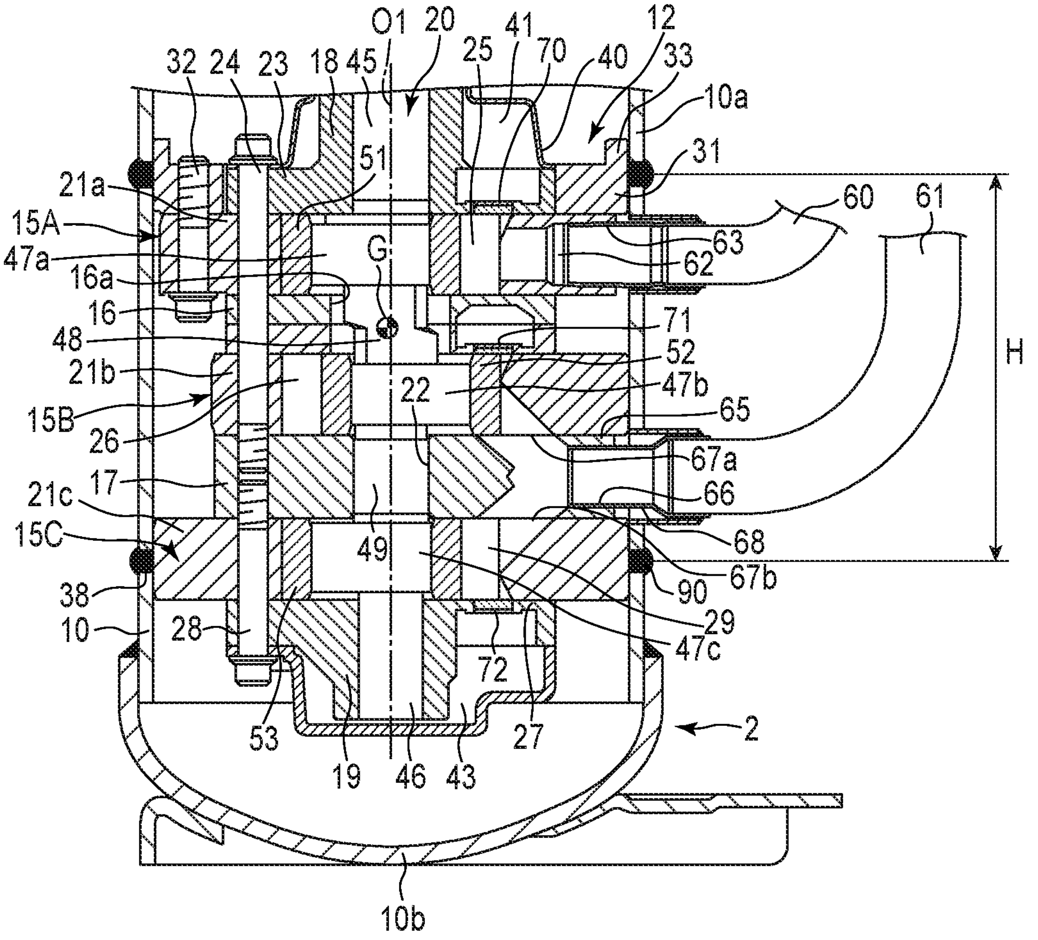
72
86
28
53
19
46
43
27
2
10b

F I G. 12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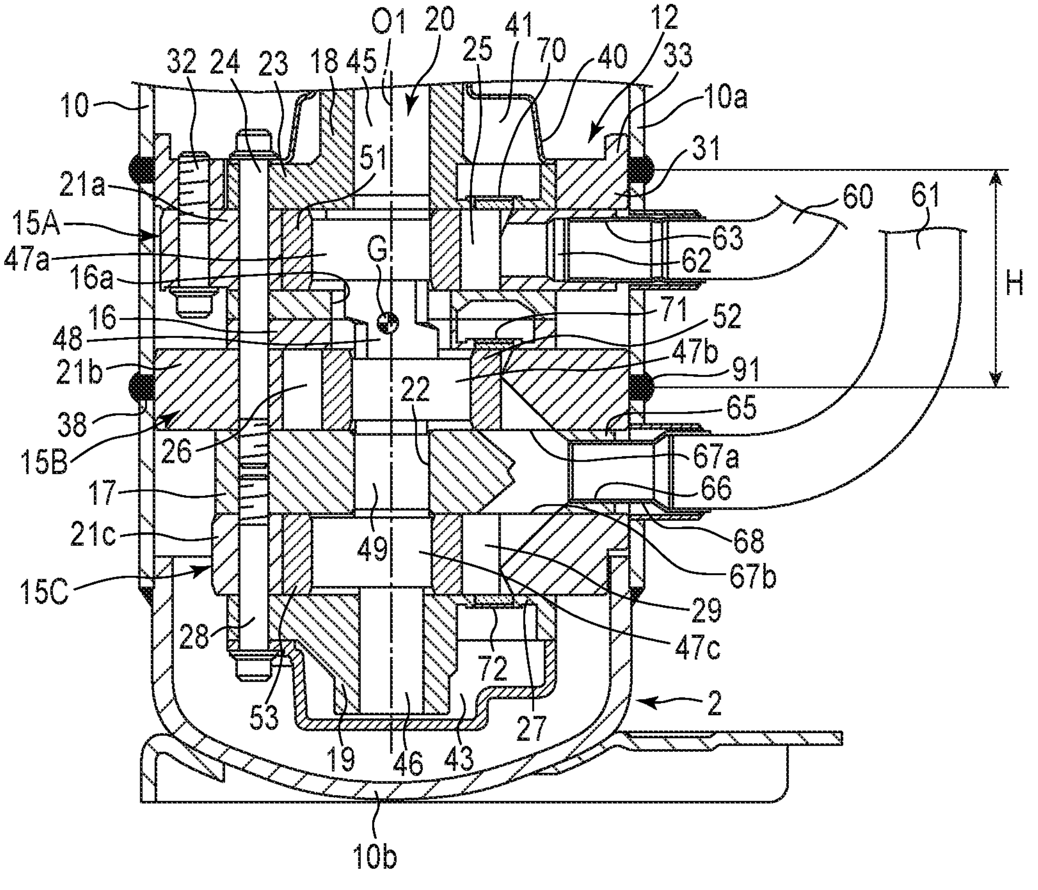
47a
16a
16
48
21b
15B
26
17
21c
15C
38
10
28
53
19
46
43
27
72
2
G
22
49
29
47c
90
67b
68
66
67a
65
47b
52
71
62
63
60
61
H
10b

FIG. 13


O1
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12
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70
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33
32
24
23
18
45
10
10a
31
21a
51
60
61
15A
63
47a
G
62
16a
H
71
16
52
48
47b
21b
91
22
38
65
15B
26
67a
17
66
21c
68
49
67b
15C
29
47c
28
72
2
53
27
19
46
43
10b

F I G. 14

ROTARY COMPRESSOR AND REFRIGERATION CYCLE APPARATUS

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a Continuation Application of PCT Application No. PCT/JP2018/014476, filed Apr. 4, 2018, the entire contents of which are incorporated herein by reference.

FIELD

Embodiments described herein relate generally to a rotary compressor of a multi-cylinder type and a refrigeration cycle apparatus comprising the rotary compressor.

BACKGROUND

Recently, a vertical three-cylinder rotary compressor having a compression mechanism unit in which three sets of refrigerant compression units are arranged in the axial direction of a rotary shaft has been developed in order to increase the compression capacity of the refrigerant. The rotating shaft used in this type of rotary compressor comprises first to third crank portions that eccentrically rotate in a cylinder chamber of a refrigerant compression unit, and a pair of middle shaft units located between the first crank portion and the second crank portion and between the second crank portion and the third crank portion.

For this reason, in the three-cylinder rotary compressor, the full length of the rotating shaft is longer and height dimensions of the compression mechanism unit increase as compared with a two-cylinder rotary compressor in which two sets of refrigerant compression units are arranged in the axial direction of the rotating shaft.

Furthermore, since the number of refrigerant compression units increases more than a two-cylinder twin rotary compressor, output of an electric motor needs to be increased and, accordingly, increase in size of the electric motor cannot be avoided.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a circuit diagram schematically showing a structure of a refrigeration cycle apparatus according to a first embodiment.

FIG. **2** is a cross-sectional view showing a three-cylinder rotary compressor according to a first embodiment.

FIG. **3** is a cross-sectional view showing a first refrigerant compression unit, schematically illustrating a positional relationship between a vane and a roller.

FIG. **4** is a cross-sectional view showing a first refrigerant compression unit, illustrating a relative positional relationship between a roller and a vane in a first cylinder chamber when a rotary angle of a crank portion of the rotary shaft is 0°.

FIG. **5** is a cross-sectional view showing a first refrigerant compression unit, illustrating a relative positional relationship between a roller and a vane in the first cylinder chamber when a rotary angle of a crank portion of the rotary shaft is 270°.

FIG. **6** is a plan view showing a second intermediate partition plate.

FIG. **7** is a plan view showing a state in which the second intermediate partition plate is divided into a pair of plate elements.

FIG. **8** is a plan view showing a positional relationship between a second suction port of a second intermediate partition plate and a second connection pipe.

FIG. **9** (A) is side view showing a second intermediate partition plate, illustrating a state where a pair of plate elements are displaced in a thickness direction. FIG. **9** (B) is a side view showing the second intermediate partition plate, illustrating a state where a displacement generated between the pair of plate elements by the second connection pipe pressed into the second suction port is corrected.

FIG. **10** is a characteristic view showing a relationship between a load acting on a rotary shaft and a rotation angle of the rotary shaft.

FIG. **11** is a cross-sectional view showing a three-cylinder rotary compressor according to a second embodiment.

FIG. **12** is a cross-sectional view showing a three-cylinder rotary compressor according to a third embodiment.

FIG. **13** is a cross-sectional view showing a three-cylinder rotary compressor according to a fourth embodiment.

FIG. **14** is a cross-sectional view showing a three-cylinder rotary compressor according to a fifth embodiment.

DETAILED DESCRIPTION

In the three-cylinder rotary compressor, a heavy large electric motor projects to the upper side of the compression mechanism unit which increases in height dimensions, and a full height of a sealed housing accommodating the compression mechanism unit and the electric motor is increased. For this reason, a position of a center of gravity of the three-cylinder rotary compressor becomes higher and there is a risk that a large vibration may occur during operation.

In general, according to one embodiments, the rotary compressor comprises a cylindrical sealed container; an electric motor including a compression mechanism unit compressing a refrigerant inside the sealed container; and an electric motor including a stator fixed to an inner peripheral surface of the sealed container on an upper side of the compression mechanism unit and a rotor surrounded by the stator to drive the compression mechanism unit inside the sealed container.

The compression mechanism unit comprises a first bearing and a second bearing arranged at intervals in the axial direction of the sealed container, first to third refrigerant compression units arranged at intervals in the axial direction between the first bearing and the second bearing, a first intermediate partition plate interposed between the first refrigerant compression unit and the second refrigerant compression unit, a second intermediate partition plate interposed between the second refrigerant compression unit and the third refrigerant compression unit, and a rotating shaft to which the rotor of the electric motor is fixed.

The rotating shaft includes a first journal portion supported by the first bearing, a second journal portion supported by the second bearing, the first to third crank portions provided between the first journal portion and the second journal portion, eccentrically rotating in the cylinder chambers of the first to third refrigerant compression portions and having rollers fitted therewith, a first intermediate shaft portion located between the first crank portion and the second crank portion, and a second intermediate shaft portion located between the second crank portion and the third crank portion.

The compression mechanism unit is fixed to the sealed container by a pair of fixing portions provided at two parts spaced apart in the axial direction of the rotating shaft, and a center of gravity of a structure including the compression mechanism unit and the rotor of the electric motor between the pair of fixing portions.

First Embodiment

The first embodiment will be described hereinafter with reference to FIG. **1** to FIG. **10**.

FIG. **1** is a refrigeration cycle circuit diagram of an air conditioner **1**, which is an example of, for example, a refrigeration cycle apparatus. The air conditioner **1** comprises a rotary compressor **2**, a four-way valve **3**, an outdoor heat exchanger **4**, an expansion device **5**, and an indoor heat exchanger **6** as main elements. The plurality of elements constituting the air conditioner **1** are connected via a circulation circuit **7** in which the refrigerant circulates.

More specifically, as shown in FIG. **1**, a discharge side of the rotary compressor **2** is connected to a first port **3***a* of a four-way valve **3**. A second port **3***b* of the four-way valve **3** is connected to the outdoor heat exchanger **4**. The outdoor heat exchanger **4** is connected to the indoor heat exchanger **6** via the expansion device **5**. The indoor heat exchanger **6** is connected to a third port **3***c* of the four-way valve **3**. A fourth port **3***d* of the four-way valve **3** is connected to a suction side of the rotary compressor **2** via an accumulator **8**.

When the air conditioner **1** operates in a cooling mode, the four-way valve **3** is switched such that the first port **3***a* communicates with the second port **3***b* and the third port **3***c* communicates with the fourth port **3***d*. When the operation of the air conditioner **1** is started in a cooling mode, a high-temperature and high-pressure vapor-phase refrigerant compressed by the rotary compressor **2** is led to the outdoor heat exchanger **4** which functions as radiator (condenser) via the four-way valve **3**.

The vapor-phase refrigerant led to the outdoor heat exchanger **4** is condensed by heat exchange with the air, and changed into a high-pressure liquid-phase refrigerant. The high-pressure liquid-phase refrigerant is reduced in pressure in a process of passing through the expansion device **5** and is changed to a low-pressure gas-liquid two-phase refrigerant. The gas-liquid two-phase refrigerant is led to the indoor heat exchanger **6** which functions as a heat absorber (evaporator), and exchanges heat with air in a process of passing through the indoor heat exchanger **6**.

As a result, the gas-liquid two-phase refrigerant takes heat from the air, evaporates, and changes to a low-temperature and low-pressure vapor-phase refrigerant. The air passing through the indoor heat exchanger **6** is cooled by the latent heat of vaporization of the liquid-phase refrigerant and is sent to a place to be air-conditioned (cooled) as cold air.

The low-temperature and low-pressure vapor-phase refrigerant passing through the indoor heat exchanger **6** is led to the accumulator **8** via the four-way valve **3**. When the liquid-phase refrigerant which could not evaporate is mixed in the refrigerant, the refrigerant is separated into liquid-phase refrigerant and vapor-phase refrigerant in the accumulator **8**. The low-temperature and low-pressure vapor-phase refrigerant from which the liquid-phase refrigerant has been separated is sucked into the rotary compressor **2** and is compressed again into the high-temperature and high-pressure vapor-phase refrigerant by the rotary compressor **2** and discharged to the circulation circuit **7**.

In contrast, when the air conditioner **1** operates in a heating mode, the four-way valve **3** switches such that the first port **3***a* communicates with third port **3***c* and the second port **3***b* communicates with the fourth port **3***d*. For this reason, the high-temperature and high-pressure vapor-phase refrigerant discharged from the rotary compressor **2** is led to the indoor heat exchanger **6** via the four-way valve **3** and exchanges heat with air passing through the indoor heat exchanger **6**. That is, the indoor heat exchanger **6** functions as a condenser.

As a result, the vapor-phase refrigerant passing through the indoor heat exchanger **6** is condensed by heat exchange with the air, and changed into a high-pressure liquid-phase refrigerant. The air passing through the indoor heat exchanger **6** is heated by heat exchange with the vapor-phase refrigerant and is sent to a place to be air-conditioned (heated) as warm air.

The high-temperature liquid-phase refrigerant that has passed through the indoor heat exchanger **6** is led to the expansion device **5** and is reduced in pressure in a process of passing through the expansion device **5** and changes into a low-pressure gas-liquid two-phase refrigerant. The gas-liquid two-phase refrigerant is led to the outdoor heat exchanger **4** which functions as an evaporator, and evaporates by exchanging heat with air, and changes to a low-temperature and low-pressure vapor-phase refrigerant. The low-temperature and low-pressure vapor-phase refrigerant that has passed through the outdoor heat exchanger **4** is sucked into the rotary compressor **2** via the four-way valve **3** and the accumulator **8**.

Next, a concrete configuration of the rotary compressor **2** used in the air conditioner **1** will be described with reference to FIG. **2** to FIG. **8**. FIG. **2** is a cross-sectional view showing the vertical three-cylinder rotary compressor **2**. As shown in FIG. **2**, the three-cylinder rotary compressor **2** comprises a sealed container **10**, an electric motor **11**, and a compression mechanism unit **12** as main elements.

The sealed container **10** is divided into, for example, three elements, i.e., a container body **10***a*, a bottom member **10***b*, and a lid member **10***c*. The container body **10***a* has a cylindrical peripheral wall **10***d* and is erected along the vertical direction. The bottom member **10***b* is welded to a lower end of the container body **10***a* so as to airtightly close a lower end opening of the container body **10***a*. The lid member **10***c* is welded to an upper end of the container body **10***a* so as to airtightly close an upper end opening of the container body **10***a*.

A discharge pipe **10***e* is attached to the lid member **10***c* of the sealed container **10**. The discharge pipe **10***e* is connected to the first port **3***a* of the four-way valve **3** via the circulation circuit **7**. Furthermore, a lubricating oil that lubricates the compression mechanism unit **12** is stored in a lower part of the sealed container **10**.

The electric motor **11** is accommodated in an intermediate portion along the axial direction of the sealed container **10** so as to be positioned above the oil level of the lubricating oil. The electric motor **11** is a so-called inner rotor type motor, and comprises a stator **13** and a rotor **14**. The stator **13** is fixed to an inner surface of a peripheral wall **10***d* of the container body **10***a*. The rotor **14** is coaxially positioned on a central axis of the sealed container **10** and is surrounded by the stator **13**.

The compression mechanism unit **12** is accommodated in the lower part of the sealed container **10** so as to be immersed in the lubricating oil. The compression mechanism unit **12** comprises a first refrigerant compression unit **15**A, a second refrigerant compression unit **15**B, a third refrigerant compression unit **15**C, a first intermediate partition plate **16**, a second intermediate partition plate **17**, a first bearing **18**, a second bearing **19**, and a rotating shaft **20** as main elements.

The first to third refrigerant compression units **15**A, **15**B, and **15**C are arranged at intervals in a line in the axial direction of the sealed container **10**. The first to third refrigerant compression units **15**A, **15**B, and **15**C have a first cylinder body **21***a*, a second cylinder body **21***b*, and a third cylinder body **21***c*, respectively. For example, the first to third cylinder bodies **21***a*, **21***b*, and **21***c* are set to have the same thickness along the axial direction of the sealed container **10**.

The first intermediate partition plate **16** is interposed between the first cylinder body **21***a* and the second cylinder body **21***b*. An upper surface of the first intermediate partition plate **16** is overlaid on a lower surface of the first cylinder body **21***a* so as to cover an inner diameter portion of the first cylinder body **21***a* from below. A lower surface of the first intermediate partition plate **16** is overlaid on an upper surface of the second cylinder body **21***b* so as to cover an inner diameter portion of the second cylinder body **21***b* from above.

Furthermore, a through hole **16***a* is formed in a central portion of the first intermediate partition plate **16**. The through hole **16***a* is located between the inner diameter portion of the first cylinder body **21***a* and the inner diameter portion of the second cylinder body **21***b*.

The second intermediate partition plate **17** is interposed between the second cylinder body **21***b* and the third cylinder body **21***c*. An upper surface of the second intermediate partition plate **17** is overlaid on a lower surface of the second cylinder body **21***b* so as to cover the inner diameter portion of the second cylinder body **21***b* from below. A lower surface of the second intermediate partition plate **17** is overlaid on an upper surface of the third cylinder body **21***c* so as to cover an inner diameter portion of the third cylinder body **21***c* from above.

Furthermore, a circular bearing hole **22** is formed in a central portion of the second intermediate partition plate **17**. The bearing hole **22** is located between the inner diameter portion of the second cylinder body **21***b* and the inner diameter portion of the third cylinder body **21***c*.

The first intermediate partition plate **16** and the second intermediate partition plate **17** have thicknesses T**1** and T**2** along the axial direction of the sealed container **10**, respectively. According to the present embodiment, the thickness T**2** of the second intermediate partition plate **17** is larger than the thickness T**1** of the first intermediate partition plate **16**.

As shown in FIG. **2**, the first bearing **18** is positioned on the first cylinder body **21***a*. The first bearing **18** has a flange portion **23** projecting toward the peripheral wall **10***d* of the container body **10***a*. The flange portion **23** is overlaid on the upper surface of the first cylinder body **21***a* so as to cover the inner diameter portion of the first cylinder body **21***a* from above.

The flange portion **23** of the first bearing **18**, the first cylinder body **21***a*, the first intermediate partition plate **16**, the second cylinder body **21***b*, and the second intermediate partition plate **17** are stacked in the axial direction of the sealed container **10**, and are integrally connected via a plurality of first fastening bolts **24** (only one is shown).

A region surrounded by the inner diameter portion of the first cylinder body **21***a*, the first intermediate partition plate **16**, and the flange portion **23** of the first bearing **18** defines a first cylinder chamber **25**. A region surrounded by the inner diameter portion of the second cylinder body **21***b*, the first intermediate partition plate **16**, and the second intermediate partition plate **17** defines a second cylinder chamber **26**.

The second bearing **19** is positioned below the third cylinder body **21***c*. The second bearing **19** has a flange portion **27** protruding toward the peripheral wall **10***d* of the container body **10***a*. The flange portion **27** is overlaid on the lower surface of the third cylinder body **21***c* so as to cover the inner diameter portion of the third cylinder body **21***c* from below.

The flange portion **27** of the second bearing **19**, the third cylinder body **21***c*, and the second intermediate partition plate **17** are stacked in the axial direction of the sealed container **10** and are integrally connected via a plurality of second fastening bolts **28** (only one shown). A region surrounded by the inner diameter portion of the third cylinder body **21** *c*, the second intermediate partition plate **17**, and the flange portion **27** of the second bearing **19** defines a third cylinder chamber **29**.

Accordingly, the first bearing **18** and the second bearing **19** are separated from each other in the axial direction of the sealed container **10**, and the first to third cylinder bodies **21***a*, **21***b*, and **21***c*, the first intermediate partition plate **16** and the second intermediate partition plate **17** are alternately positioned between the first bearing **18** and the second bearing **19**.

According to the present embodiment, the flange portion **23** of the first bearing **18** is surrounded by a ring-shaped first support member **31**. The first support member **31** has a thickness equivalent to the flange portion **23** of the first bearing **18**. The lower surface of the first support member **31** is overlaid on the upper surface of an outer peripheral portion of the first cylinder body **21***a* closest to the electric motor **11**. The first support member **31** and the outer peripheral portion of the first cylinder body **21***a* are firmly coupled via a plurality of third fastening bolts **32** (only one shown).

Furthermore, the outer peripheral portion of the first support member **31** is extended upward of the container body **10***a* in order to ensure a contact area with the inner surface of the peripheral wall **10***d* of the container body **10***a*. The outer peripheral portion of the first support member **31** is fixed to a predetermined position of the container body **10***a* by means such as welding. For this reason, the first support member **31** welded to the container body **10***a* constitutes a first fixing portion **33** that fixes the upper end part of the compression mechanism portion **12** to the sealed container **10**.

As shown in FIG. **2**, the outer peripheral portion of the third cylinder body **21***c* projects outward from the flange portion **27** of the second bearing **19** along the radial direction of the sealed container **10**. A ring-shaped second support member **34** is attached to the lower surface of the outer peripheral portion of the third cylinder body **21***c* farthest from the electric motor **11**. The second support member **34** comprises a flat ring portion **35** that receives the lower surface of the outer peripheral portion of the third cylinder body **21***c*, and a cylindrical fitting portion **36** that is folded downward from the outer peripheral edge of the ring portion **35**.

The ring portion **35** is coupled to the lower surface of the outer peripheral portion of the third cylinder body **21***c* via a plurality of fourth fastening bolts **37**. The fitting portion **36** is fitted inside the peripheral wall **10***d* of the container body **10***a*, and the fitting portion **36** is fixed to a predetermined position of the container body **10***a* by means such as welding.

For this reason, the second support member **34** welded to the container body **10***a* constitutes a second fixing portion **38** that fixes the lower end part of the compression mechanism portion **12** to the sealed container **10**. The second fixing portion **38** is separated from the first fixing portion **33** by a distance H in the axial direction of the sealed container **10**.

A first discharge muffler **40** is attached to the first bearing **18**. A first silencing chamber **41** is formed between the first discharge muffler **40** and the first bearing **18**. The first silencing chamber **41** is opened inside the sealed container **10** through an exhaust hole (not shown) of the first discharge muffler **40**.

The second discharge muffler **42** is attached to the second bearing **19**. A second silencing chamber **43** is formed between the second discharge muffler **42** and the second bearing **19**. The second silencing chamber **43** communicates with the first silencing chamber **41** via a discharge passage (not shown) extending in the axial direction of the sealed container **10**.

As shown in FIG. **2**, the rotating shaft **20** is coaxially positioned on the central axis of the sealed container **10**. The rotating shaft **20** is an integrated structure having a first journal portion **45**, a second journal portion **46**, first to third crank portions **47***a*, **47***b*, and **47***c*, a first intermediate shaft portion **48**, and a second intermediate shaft portion **49**.

The first journal portion **45** is positioned at an intermediate portion along the axial direction of the rotating shaft **20** and is rotatably supported by the first bearing **18**. The rotor **14** of the electric motor **11** is fixed to an upper end part of the rotating shaft **20** protruding from the first bearing **18**.

The second journal portion **46** is provided coaxially with the first journal portion **45** so as to be positioned at the lower end part of the rotating shaft **20**. The second journal portion **46** is rotatably supported by the second bearing **19**.

The first to the third crank portions **47***a*, **47***b*, and **47***c* are located between the first journal portion **45** and the second journal portion **46** and are arranged at intervals in the axial direction of rotating shaft **20**. The first to third crank portions **47***a*, **47***b*, and **47***c* are disk-shaped elements each having a circular cross-sectional shape and, in the present embodiment, the thickness dimension and the diameter along the axial direction of the rotating shaft **20** are set to be the same.

The first to third crank portions **47***a*, **47***b*, and **47***c* are eccentric with respect to a rotation center line O1 of the rotating shaft **20**, and the eccentric directions are shifted by 120° in a circumferential direction of the rotating shaft **20**. The first crank portion **47***a* is located in the first cylinder chamber **25**. The second crank portion **47***b* is located in the second cylinder chamber **26**. The third crank portion **47***c* is located in the third cylinder chamber **29**.

The first intermediate shaft portion **48** is located between the first crank portion **47***a* and the second crank portion **47***b* on the rotation center line O1 of the rotating shaft **20**, and penetrates the through hole **16***a* of the first intermediate partition plate **16**.

The second middle shaft **49** is located between the second crank portion **47***b* and the third crank portion **47***c* on the rotation center line O1 of the rotating shaft **20**, and is slidably fitted in the bearing hole **22** of the second intermediate partition plate **17** in the shaft circumference direction. By this fitting, the second intermediate partition plate **17** also functions as a third bearing that supports the rotating shaft **20** between the first bearing **18** and the second bearing **19**.

A ring-shaped roller **51** is fitted in the outer peripheral surface of the first crank portion **47***a*. The roller **51** follows the rotating shaft **20** and eccentrically rotates in the first cylinder chamber **25**, and a part of the outer peripheral surface of the roller **51** brings is slidably in line contact with the inner peripheral surface of the inner diameter portion of the first cylinder body **21***a*.

An upper end surface of the roller **51** is slidably in contact with the lower surface of the flange **23** of the first bearing **18**. A lower end surface of the roller **51** is slidably in contact with the upper surface of the first intermediate partition plate **16**. The airtightness of the first cylinder chamber **25** is thereby secured.

A ring-shaped roller **52** is fitted in the outer peripheral surface of the second crank portion **47***b*. The roller **52** follows the rotating shaft **20** and eccentrically rotates in the second cylinder chamber **26**, and a part of the outer peripheral surface of roller **52** brings is slidably in line contact with the inner peripheral surface of the inner diameter portion of the second cylinder body **21***b*.

The upper end surface of the roller **52** is slidably in contact with the under surface of the first intermediate partition plate **16**. The lower end surface of the roller **52** is slidably in contact with the upper surface of the second intermediate partition plate **17**. The airtightness of the second cylinder chamber **26** is thereby secured.

A ring-shaped roller **53** is fitted in the outer peripheral surface of the third crank portion **47***c*. The roller **53** follows the rotating shaft **20** and eccentrically rotates in the third cylinder chamber **29**, and a part of the outer peripheral surface of roller **53** brings is slidably in line contact with the inner peripheral surface of the inner diameter portion of third cylinder body **21***c*.

The upper end surface of roller **53** is slidably in contact with the under surface of the second intermediate partition plate **17**. The lower end surface of the roller **53** is slidably in contact with the upper surface of flange **27** of the second bearing **19**. The airtightness of the third cylinder chamber **29** is thereby secured.

As shown in FIG. **3** to FIG. **5** as a representative of the first cylinder body **21***a*, vane slots **55** are formed in the first to third cylinder bodies **21***a*, **21***b*, and **21***c*, respectively. The vane slot **55** extends to the radial direction of the first cylinder chamber **25**.

A vane **56** is accommodated in the vane slot **55**. The vane **56** is movable along the vane slot **55** in the radial direction of the first cylinder chamber **25** and is urged toward the first cylinder chamber **25** via a spring **57**. A tip of the vane **56** is slidably pressed against the outer peripheral surface of the roller **51**.

The vane **56** divides the first cylinder chamber **25** into a suction region R1 and a compression region R2 in cooperation with the roller **51**. Furthermore, the vane **56** can reciprocate between a protruding position P1 and an immersion position P2 following the eccentric rotation of the roller **51**.

FIG. **3** discloses a state in which the vane **56** is moved to the protruding position P1. At the protruding position P1, the vane **56** protrude most into the first cylinder chamber **25**. At the immersion position P2, the vane **56** is pushed into the vane slot **55** so as to retreat from the first cylinder chamber **25**. As a result, when the roller **51** rotates eccentrically, the volumes of the suction region R1 and the compression region R2 of the first cylinder chamber **25** change continuously.

Although not shown, the second cylinder chamber **26** and the third cylinder chamber **29** are also divided into a suction region and a compression region by the same vane. For this reason, when the rollers **52** and **53** eccentrically rotate, the volumes of the suction region and the compression region in the second cylinder chamber **26** and the third cylinder chamber **29** change continually.

As shown in FIG. **2**, the first cylinder chamber **25** is connected to the accumulator **8** via a first suction pipe **60**.

The second cylinder chamber **26** and third cylinder chamber **29** are connected to the accumulator **8** via the second intermediate partition plate **17** and a second suction pipe **61**.

More specifically, as shown in FIG. **3**, a first suction port **62** that is continuous with the suction region R1 of the first cylinder chamber **25** is formed in the first cylinder body **21***a*. The first suction port **62** is opened on the outer surface of the first cylinder body **21***a* and extends from the opening end toward the center of the first cylinder chamber **25**.

Furthermore, a first connection pipe **63** is press-fitted from the outside of the first cylinder body **21***a* into the first suction port **62**. The first connecting pipe **63** penetrates the peripheral wall **10***d* of the container body **10***a* and protrudes out of the sealed container **10**, and a downstream end of the first suction pipe **60** is inserted airtight into the inside of the first connecting pipe **63**.

As shown in FIG. **6**, a joint portion **65** is formed on a part of the outer peripheral portion of the second intermediate partition plate **17**. The joint portion **65** protrudes from the outer peripheral portion of the second intermediate partition plate **17** toward the peripheral wall **10***d* of the container main body **10***a*. A second suction port **66** and two branch passages **67***a* and **67***b* branched in a bifurcated manner from the downstream end of the second suction port **66** are formed inside the joint portion **65**.

The second suction port **66** is opened at the protruding end of the joint portion **65** and extends from the protruding end toward the center of the second intermediate partition plate **17**. Furthermore, a second connection pipe **68** is press-fitted into the second suction port **66** from the outside of the second intermediate partition plate **17**. The second connecting pipe **68** penetrates the peripheral wall **10***d* of the container body **10***a* and protrudes out of the sealed container **10**, and a downstream end of the second suction pipe **61** is inserted airtight into the inside of the second connecting pipe **68**.

One branch passage **67***a* is opened on the upper surface of the second intermediate partition plate **17** so as to communicate with the second cylinder chamber **26**. The other branch passage **67***b* is opened on the lower surface of the second intermediate partition plate **17** so as to communicate with the third cylinder chamber **29**.

As shown in FIG. **2**, a first discharge valve **70** that opens when the pressure in the compression region R2 of the first cylinder chamber **25** reaches a predetermined value is provided in the flange portion **23** of the first bearing **18**. The discharge side of the first discharge valve **70** communicates with the first silencing chamber **41**.

A second discharge valve **71** that opens when the pressure in the compression region R2 of the second cylinder chamber **26** reaches a predetermined value is provided in the first intermediate partition plate **16**. The discharge side of the second discharge valve **71** communicates with the first silencing chamber **41** through a discharge passage (not shown) provided in the first intermediate partition plate **16** and in the first cylinder body **21***a*.

A third discharge valve **72** that opens when the pressure in the compression region R2 of the third cylinder chamber **29** reaches a predetermined value is provided in the flange portion **27** of the second bearing **19**. The discharge side of the third discharge valve **72** communicates with the second silencing chamber **43**.

In such a three-cylinder rotary compressor **2**, when the rotating shaft **20** is rotated by the electric motor **11**, the rollers **51**, **52**, and **53** follow the first to third crank portions **47***a*, **47***b*, and **47***c* and eccentrically rotate in the first to third cylinder chambers **25**, **26**, and **29**. As a result, the volumes of the suction region R1 and the compression region R2 of the first to third cylinder chambers **25**, **26**, and **29** change, and the vapor-phase refrigerant in the accumulator **8** is sucked from the first suction pipe **60** and the second suction pipe **61** into the suction region R1 of the first to third cylinder chambers **25**, **26**, and **29**.

The vapor-phase refrigerant sucked into the suction region R1 of the first cylinder chamber **25** from the first suction pipe **60** through the first suction port **62** is gradually compressed in a process in which the suction region R1 moves to the compression region R2. When the pressure of the vapor-phase refrigerant reaches a predetermined value, the first discharge valve **70** is opened, and the vapor-phase refrigerant compressed in the first cylinder chamber **25** is discharged into the first silencing chamber **41**.

Part of the vapor-phase refrigerant led from the second suction pipe **61** to the second suction port **66** of the second intermediate partition plate **17** is sucked into the suction region R1 of the second cylinder chamber **26** through the branch passage **67***a*. The vapor-phase refrigerant sucked into the suction region R1 of the second cylinder chamber **26** is gradually compressed in the process in which the suction region R1 moves to the compression region R2. When the pressure of the vapor-phase refrigerant reaches a predetermined value, the second discharge valve **71** is opened, and the vapor-phase refrigerant compressed in the second cylinder chamber **26** is led to the first silencing chamber **41** through a discharge passage.

The remaining vapor-phase refrigerant led to the second suction opening **66** of the second intermediate partition plate **17** from the second suction pipe **61** is sucked into the suction region R1 of the third cylinder chamber **29** through the other branch passage **67***b*. The vapor-phase refrigerant sucked into the suction region R1 of the third cylinder chamber **29** is gradually compressed in the process in which the suction region R1 moves to the compression region R2. When the pressure of the vapor-phase refrigerant reaches a predetermined value, the third discharge valve **72** is opened, and the vapor-phase refrigerant compressed in the third cylinder chamber **29** is discharged into the second silencing chamber **43**. The vapor-phase refrigerant discharged into the second silencing chamber **43** is led to the first silencing chamber **41** through a discharge passage.

The eccentric directions of the first to third crank portions **47***a*, **47***b*, and **47***c* of the rotating shaft **20** are shifted by 120° in the circumferential direction of the rotating shaft **20**. For this reason, there is a phase difference equivalent to the timing at which the vapor-phase refrigerants compressed in the first to third cylinder chambers **25**, **26**, and **29** are discharged.

The vapor-phase refrigerants compressed in the first to third cylinder chambers **25**, **26**, and **29** merge in the first silencing chamber **41** and are continuously discharged from the exhaust hole of the first discharge muffler **40** to the inside of the sealed container **10**. After having passed through the electric motor **11**, the vapor-phase refrigerant discharged into the sealed container **10** is led to the four-way valve **3** from the discharge pipe **10***e*.

In the three-cylinder rotary compressor **2** of the present embodiment, the upper end part of the compression mechanism portion **12** having the first to third refrigerant compression units **15**A, **15**B, and **15**C is fixed to the sealed container **10** by the first fixing portion **33**, and the lower end part of the compression mechanism unit **12** is fixed to the sealed container **10** by the second fixing portion **38**.

That is, the compression mechanism unit **12** is fixed to the sealed container **10** at two locations spaced in the axial direction of the rotating shaft **20**, and the first fixing portion **33** and the second fixing portion **38** are separated by distance H in the axial direction of the rotating shaft **20**.

Furthermore, in the present embodiment, the center of gravity G of the structure including the rotor **14** of the electric motor **11** and the compression mechanism unit **12** is located within the range of the distance H between the fixing portion **33** and the second fixing portion **38** by, for example, optimizing the weight distribution of various components constituting the compression mechanism unit **12**. More specifically, as shown in FIG. **2**, the center of gravity G is located on the axis of the first intermediate shaft portion **48** straddling between the first crank portion **47***a* and the second crank portion **47***b*.

On the other hand, in the three-cylinder rotary compressor **2** of the present embodiment, the suction region R**1** of the second cylinder chamber **26** and the third cylinder chamber **29** is connected to the accumulator **8** through the second suction port **66** provided in the second intermediate partition plate **17** and the branch passages **67***a* and **67***b*.

For this reason, the second cylinder chamber **26** and third cylinder chamber **29** inevitably have a longer refrigerant suction path than the first cylinder chamber **25**. Therefore, in order to make the pressure loss that occurs when the second cylinder chamber **26** and the third cylinder chamber **29** are in the suction stroke equal to the pressure loss that occurs in the first cylinder chamber **25**, the volume of the refrigerant suction path as a whole needs to be larger.

As a result, the thickness T**2** of the second intermediate partition plate **17** having the second suction port **66** and the branch passages **67***a* and **67***b* is increased, and the entire length of the second intermediate shaft portion **49** extending between the second crank portion **47***b* and the third crank portion **47***c* becomes longer accordingly.

Therefore, in the present embodiment, in order to suppress the bending of the rotating shaft **20**, the bearing hole **22** that rotatably supports the second intermediate shaft portion **49** is formed in the second intermediate partition plate **17**, and the second intermediate partition plate **17** also functions as a third bearing that supports the rotary shaft **20**.

In this case, since the rotary shaft **20** is an integral structure, the second intermediate shaft portion **49** of the rotating shaft **20** cannot be fitted into the bearing hole **22** of the second intermediate partition plate **17** unless the second intermediate partition plate **17** is divided.

Therefore, in the present embodiment, as shown in FIG. **6** to FIG. **8**, the second intermediate partition plate **17** is divided into a first plate element **75***a* and a second plate element **75***b* along a radial direction of the second intermediate shaft portion **49**. The first plate element **75***a* and the second plate element **75***b* have perpendicular bonding surfaces **76***a* and **76***b* along the axial direction of the second intermediate shaft portion **49**, respectively. The bonding surfaces **76***a* and **76***b* are made to abut on each other and define a straight line-shaped dividing line X. The dividing line X extends in the radial direction of the second intermediate partition plate **17** so as to connect, for example, the center of the second suction port **66** and the center of the bearing hole **22**.

As shown in FIG. **7**, first recess portions **77***a* and **77***b* that are curved in an arc shape are formed on the first plate element **75***a* and the second plate element **75***b*, respectively. When the bonding surface **76***a* of the first plate element **75***a* and the bonding surface **76***b* of the second plate element **75***b* are made to abut, the first recess portions **77***a* and **77***b* cooperate to define the bearing hole **22**.

For this reason, when the bonding surface **76***a* of the first plate element **75***a* and the bonding surface **76***b* of the second plate element **75***b* are made to abut, the second intermediate shaft portion **49** of the rotary shaft **20** sandwiched between the first recess portions **77***a* and **77***b* from the radial direction, such that the second intermediate shaft portion **49** is slidably inserted into the bearing hole **22**.

Furthermore, second recess portions **78***a* and **78***b* that are curved in an arc shape are formed at end portions of the bonding surfaces **76***a* and **76***b* of the first plate element **75***a* and the second plate element **75***b*, respectively. When the bonding surface **76***a* of the first plate element **75***a* and the bonding surface **76***b* of the second plate element **75***b* are made to abut, the second recess portions **78***a* and **78***b* cooperate to define the second suction port **66**. For this reason, the second connection pipe **68** is press-fitted between the second recess portions **78***a* and **78***b*, and the outer peripheral surface of the second connection pipe **68** is in contact with the inner peripheral surfaces of the second recess portions **78***a* and **78***b*.

In addition, the branch passages **67***a* and **67***b* of the second intermediate partition plate **17** are positioned on the dividing line X, and parts of the second recess portions **78***a* and **78***b* constitute the branch passages **67***a* and **67***b*.

In the three-cylinder rotary compressor **2**, when the vapor-phase refrigerant is compressed in the first to third cylinder chambers **25**, **26**, and **29**, a load is generated to press the rotating shaft **20** in the radial direction. A white arrow Y shown in FIG. **3** indicates a direction of the load that the rotating shaft **20** receives due to the load when the roller **51** compresses the vapor-phase refrigerant in the first cylinder chamber **25**.

In the compression stroke in which the vapor-phase refrigerant is compressed, the load applied to the rotating shaft **20** varies depending on the rotation angle of the rotating shaft **20**, and the load that the inner peripheral surface of the bearing hole **22** of the second intermediate partition plate **17** supporting the rotating shaft **20** receives also varies depending on the circumferential position of the bearing hole **22**.

FIG. **10** shows a relationship between the rotation angle of the second crank portion **47***b* located on the upper side of the second intermediate partition plate **17** and the load acting on the rotating shaft **20**, and the direction of the load which the inner peripheral surface of the bearing hole **22** receives when the load acts on the rotating shaft **20**. The load acting on the rotating shaft **20** is the sum of the forces with which the first to third crank portions **47***a*, **47***b*, and **47***c* are pushed through the rollers **51**, **52**, and **53**.

Furthermore, the rotation angle of the rotary shaft **20** is indicative of an angle in the rotation direction of the rotating shaft **20** when the eccentric direction of the second crank portion **47***b* is the direction of the vane **56** and the position where the vane **56** is most pushed into the vane slot **55** is referred to as the reference (0°).

As shown in FIG. **10**, the load acting on the rotary shaft **20** reaches a peak when the rotation angle of the second crank portion **47***b* is approximately in the range of 120° to 250°, and decreases rapidly when the rotation angle exceeds 250°.

According to the present embodiment, the load acting on the rotary shaft **20** reaches 85% of the peak value when the rotation angle of the second crank portion **47***b* is approximately in the range of 110° to 280°. When the rotation angle of the second crank portion **47***b* is approximately 110°, the load acts on the bearing hole **22** of the second intermediate partition plate **17** in the direction of 50° in the rotation direction of the shaft **20**, using a direction of the vane **56** as a reference position, as seen from the axial direction of the rotating shaft **20**.

Furthermore, when the rotation angle of the second crank portion **47***b* is approximately 280°, the load acts on the bearing hole **22** of the second intermediate partition plate **17** in the direction of 150°.

FIG. **6** shows a positional relationship between the dividing line X and the vane **56**, of the second intermediate partition plate **17** divided into two parts. As is apparent from FIG. **6**, the dividing line X of the second intermediate partition plate **17** is provided at a position displaced from a range θ of 50° to 150° in the rotation direction of the rotating shaft **20**, using the direction of the vane **56** as a reference position, as seen from the axial direction of the rotating shaft **20**.

For this reason, the bonding surfaces **76***a* and **76***b* of the first plate element **75***a* and the second plate element **75***b* that define the dividing line X are provided at positions where the load acting on the bearing hole **22** from the rotating shaft **20** is 85% or less of the peak value.

According to the first embodiment, the center of gravity G of the structure including the rotor **14** of the electric motor **11** and the compression mechanism unit **12** is located on the axis of the first intermediate shaft portion **48** extending between the first crank portion **47***a* and the second crank portion **47***b*, within the range of the distance H between the first fixing portion **33** and the second fixing portion **38**.

According to this configuration, when the vapor-phase refrigerant is compressed, the pressure fluctuation occurs in the three places of the first to third cylinder chambers **25**, **26**, and **29**, but occurrence of large variations in the distance from the three places where the pressure fluctuation occurs to the center of gravity G can be avoided. Therefore, the compression mechanism unit **12** serving as a vibration source can be firmly supported by the sealed container **10** and the vibration of the compression mechanism unit **12** can be suppressed.

Therefore, the high-reliability three-cylinder rotary compressor **2** suppressing vibrations that cause noise and various troubles can be provided.

Furthermore, in the first embodiment, the second intermediate partition plate **17** also functions as the third bearing that rotatably supports the second intermediate shaft portion **49** of rotating shaft **20**. For this reason, a bend and a shaft deflection of the rotating shaft **20** at the time of operation of the three-cylinder rotary compressor **2** can be suppressed, and this also contributes to the reduction of vibration and noise of the three-cylinder rotary compressor **2**.

In addition, the dividing line X that passes through the bonding surfaces **76***a* and **76***b* of the second intermediate partition plate **17** is provided at a position deviating from the range θ of 50° to 150° in the rotation direction of the rotating shaft **20**, using the direction of vane **56** as a reference position (reference point), as seen from the axial direction of the rotating shaft **20**.

A slight step or the like is likely to occur at a bonding portion of the bearing hole **22** formed at the first recess portions **77***a* and **77***b*. However, by employing the above configuration, large load acting on the bonding portion of the bearing hole **22** can be avoided although the second intermediate partition plate **17** is divided into the first plate element **75***a* and the second plate element **75***b*. For this reason, wear of the bearing hole **22** and the second intermediate shaft portion **49** can be prevented.

Furthermore, since the second suction port **66** is located on the dividing line X, the second recess portions **78***a* and **78***b* formed on the bonding surfaces **76***a* and **76***b* of the first plate element **75***a* and the second plate element **75***b* cooperate to define the second suction port **66** when the bonding surfaces **76***a* and **76***b* are made to abut.

In this case, as shown by a white arrow in (A) of FIG. **9**, a bolt fastening force is applied to the second intermediate partition plate **17** from the side of the second cylinder body **21***b* and the third cylinder body **21***c*. At this time, for example, when variations occur in the bolt fastening force, the first plate element **75***a* and the second plate element **75***b* are displaced in the thickness direction at the dividing line X and a minute step S may occur on the upper and lower surfaces of the second intermediate partition plate **17** as shown in (A) of FIG. **9**.

The upper surface and the lower surface of the second intermediate partition plate **17** are sliding surfaces with which the rollers **52** and **53** are slidably in contact. Therefore, if a step is present on the sliding surfaces, it may be one of factors that cause the rollers **52** and **53** to be worn and cause the airtightness of the second cylinder chamber **26** and the third cylinder chamber **29** to be reduced.

In the present embodiment, the second suction pipe **68** is press-fitted into the second suction port **66** defined by the second recess portions **78***a* and **78***b* from the outside of the second intermediate partition plate **17**, in a state where the second intermediate partition plate **17** is sandwiched between the second cylinder body **21***b* and the third cylinder body **21***c*.

The minute displacement which has occurred between the first plate element **75***a* and the second plate element **75***b* is corrected by the press-fitting, and the upper surface and the lower surface of the second intermediate partition plate **17** become flat surfaces having no step as shown in FIG. **9**(B).

Therefore, wear of the rollers **52** and **53** can be avoided, the airtightness of the second cylinder chamber **26** and the third cylinder chamber **29** is improved, and the leakage of the vapor-phase refrigerant can be prevented.

The position of the dividing line X dividing the second intermediate partition plate **17** is not limited to the first embodiment. For example, as indicated by a symbol Z in FIG. **6**, a dividing line may be provided at a position connecting the reference point B corresponding to the vane **56** and the center of the bearing hole **22**. The position of the dividing line is not particularly limited as long as it deviates from the range θ of 50° to 150° in the rotation direction of the rotating shaft **20**.

Furthermore, in the first embodiment, the second intermediate partition plate **17** also functions as the third bearing supporting the second intermediate shaft portion **49** of the rotating shaft **20** by forming the second intermediate partition plate **17** in a two-piece divisional structure. However, the present embodiment is not limited to this.

For example, by forming the first intermediate partition plate **16** in the two-piece divisional structure instead of the second intermediate partition plate **17**, the first intermediate partition plate **16** may function as a third bearing which supports the first intermediate shaft portion **48** of the rotating shaft **20**.

Second Embodiment

FIG. **11** discloses a second embodiment. The second embodiment is different from the first embodiment with respect to a structure that the lower end part of the compression mechanism unit **12** is fixed to the sealed container **10**. The configuration of the three-cylinder rotary compressor **2** other than this is the same as that of the first embodiment. For this reason, in the second embodiment, the same reference numerals are denoted to the same constituent portions as those of the first embodiment and their descriptions will be omitted.

As shown in FIG. **11**, a second support member **80** constituting the second fixing portion **38** is interposed between the flange portion **27** of the second bearing **19** and the container body **10***a*. The second support member **80** comprises a ring portion **81** surrounding the flange portion **27**, a cylindrical inner peripheral wall portion **82** rising from an inner peripheral edge of the ring portion **81**, and a cylindrical outer peripheral wall portion **83** rising from an outer peripheral edge of the ring portion **81**.

The inner peripheral wall portion **82** of the second support member **80** is press-fitted into the outer peripheral surface of the flange portion **27** of the second bearing **19** from below prior to the outer peripheral wall portion **83**. The outer peripheral wall portion **83** of the second support member **80** is press-fitted into the inside of the container body **10***a* from the lower end opening of the container body **10***a* before closing the lower end opening of the container body **10***a* with the bottom member **10***b*.

Even in such a configuration, the lower end part of the compression mechanism unit **12** including the first to third refrigerant compression units **15**A, **15**B, and **15**C is fixed to the sealed container **10** by the second fixing portion **38**, and the center of gravity G of the structure including the rotor **14** of the electric motor **11** and the compression mechanism unit **12** is located within the range of the distance H between the first fixing portion **33** and the second fixing portion **38**.

Third Embodiment

FIG. **12** discloses a third embodiment. The third embodiment is different from the second embodiment with respect to an element relating to the shape of the second support member **80**.

As shown in FIG. **12**, the second support member **80** according to the third embodiment comprises a ring portion **84** that surrounds the flange portion **27**, a cylindrical inner peripheral wall portion **85** that is folded downward from an inner peripheral edge of the ring portion **84**, a cylindrical outer peripheral wall portion **86** that is folded downward from an outer peripheral edge of the ring portion **84**, and a ring-shaped flange portion **87** that is folded inward from a lower end of the outer peripheral wall portion **86**.

The inner peripheral wall part **85** of the second support member **80** is press-fitted into the outer peripheral surface of the flange portion **27** of the second bearing **19** from below prior to the outer peripheral wall portion **86**. The outer peripheral wall portion **86** of the second support member **80** is press-fitted to the inside of the container body **10***a* from the lower end opening of the container body **10***a* before closing the lower end opening of the container body **10***a* with the bottom member **10***b*. The flange portion **87** abuts against the upper end part of the bottom member **10***b* when the lower end opening of the container body **10***a* is closed with the bottom member **10***b*.

Fourth Embodiment

FIG. **13** discloses a fourth embodiment. The fourth embodiment is different from the first embodiment with respect to a structure in which the lower end part of the compression mechanism unit **12** is fixed to the sealed container **10**. The configuration of the three-cylinder rotary compressor **2** other than this is the same as that of the first embodiment. For this reason, in the second embodiment, the same reference numerals are denoted to the same constituent portions as those of the first embodiment and their descriptions will be omitted.

As shown in FIG. **13**, the third cylinder body **21***c* has an outer peripheral surface formed along the inner peripheral surface of the container body **10***a*. The third cylinder body **21***c* is fitted into the inside of the container body **10***a*, and the outer peripheral surface thereof is directly fixed to a predetermined position of the container body **10***a* by means such as the welding.

For this reason, in the fourth embodiment, a welding portion **90** formed between the third cylinder body **21***c* and the container body **10***a* constitutes the second fixing portion **38** that fixes the lower end part of the compression mechanism unit **12** to the sealed container **10**.

Even in such a configuration, the lower end part of the compression mechanism unit **12** including the first to third refrigerant compression units **15**A, **15**B, and **15**C is fixed to the sealed container **10** by the second fixing portion **38**, and the center of gravity G of the structure including the rotor **14** of the electric motor **11** and the compression mechanism unit **12** is located within the range of the distance H between the first fixing portion **33** and the second fixing portion **38**.

Fifth Embodiment

FIG. **14** discloses a fifth embodiment. The fifth embodiment is different from the fourth embodiment with respect to a structure in which the lower end part of the compression mechanism unit **12** is fixed to the sealed container **10**.

As shown in FIG. **14**, the second cylinder body **21***b* has an outer peripheral surface formed along the inner peripheral surface of the container body **10***a*. The second cylinder body **21***b* is fitted into the inside of the container body **10***a*, and the outer peripheral surface thereof is directly fixed to a predetermined position of the container body **10***a* by means such as the welding.

For this reason, in the fifth embodiment, a welding portion **91** formed between the third cylinder body **21***c* and the container body **10***a* constitutes the second fixing portion **38** that fixes the lower end part of the compression mechanism unit **12** to the sealed container **10**.

Even in such a configuration, the lower end part of the compression mechanism unit **12** including the first to third refrigerant compression units **15**A, **15**B, and **15**C is fixed to the sealed container **10** by the second fixing portion **38**, and the center of gravity G of the structure including the rotor **14** of the electric motor **11** and the compression mechanism unit **12** is located within the range of the distance H between the first fixing portion **33** and the second fixing portion **38**.

While certain embodiments have been described, these embodiments have been presented by way of example only, and are not intended to limit the scope of the inventions. Indeed, the novel embodiments described herein may be embodied in a variety of other forms; furthermore, various omissions, substitutions and changes in the form of the embodiments described herein may be made without departing from the spirit of the inventions. The accompanying claims and their equivalents are intended to cover such forms or modifications as would fall within the scope and spirit of the inventions.

What is claimed is:

1. A rotary compressor comprising:

a cylindrical sealed container;

a compression mechanism unit compressing a refrigerant inside the sealed container; and an electric motor including a stator fixed to an inner peripheral surface of the sealed container on an upper side of the compression mechanism unit and a rotor surrounded by the stator to drive the compression mechanism unit inside the sealed container,

the compression mechanism unit comprising:

a first bearing and a second bearing arranged in intervals in an axial direction of the sealed container;

first to third refrigerant compression units arranged in intervals in an axial direction of the sealed container between the first bearing and the second bearing;

a first intermediate partition plate interposed between the first refrigerant compression unit and the second refrigerant compression unit;

a second intermediate partition plate interposed between the second refrigerant compression unit and the third refrigerant compression unit; and

a rotary shaft including a first journal portion supported by the first bearing, a second journal portion supported by the second bearing, the first journal portion, first to third crank portions provided between the first journal portion and the second journal portion to eccentrically rotate in cylinder chambers of the first to third refrigerant compression portions and allow rollers to be fitted, a first intermediate shaft portion located between the first crank portion and the second crank portion, and a second intermediate shaft portion located between the second crank portion and the third crank portion, the rotary shaft having the rotor of the electric motor fixed and rotating, and

the compression mechanism unit being fixed to the sealed container by a pair of fixing portions provided at two places spaced in an axial direction of the rotary shaft, a center of gravity of a structure including the compression mechanism unit and the rotor of the electric motor being located between the pair of fixing portions, wherein

the center of gravity of the structure including the compression mechanism unit and the rotor of the electric motor is located on the axis of the first intermediate shaft portion.

2. The rotary compressor of claim **1**, wherein

one of the fixing portions is composed of a first support member which is fixed to an inner peripheral surface of the sealed container and to which the first refrigerant compression unit nearest to the electric motor is coupled, and

the other fixing portion is composed of a second support member which is fixed to an inner peripheral surface of the sealed container and to which the third refrigerant compression unit farthest from the electric motor is coupled.

3. The rotary compressor of claim **1**, wherein

one of the fixing portions is composed of a first support member which is fixed to an inner peripheral surface of the sealed container and to which the first refrigerant compression unit nearest to the electric motor is coupled, and

the other fixing portion is composed of a second support member interposed between an inner peripheral surface of the sealed container and an outer peripheral surface of the second bearing located at a lowermost part of the compression mechanism unit, and the second support member is press-fitted into the inner peripheral surface of the sealed container and the outer peripheral surface of the second bearing.

4. The rotary compressor of claim **1**, wherein

one of the fixing portions is composed of a support member which is fixed to an inner peripheral surface of the sealed container and to which the first refrigerant compression unit nearest to the electric motor is coupled, and

the other fixing portion is composed of a welding portion formed between an outer peripheral portion of the second refrigerant compression unit and the sealed container or between the third refrigerant compression unit and the sealed container.

5. The rotary compressor of claim **1**, wherein

each of the first to third refrigerant compression units of the compression mechanism unit includes a vane dividing the cylinder chamber into a suction region and a compression region,

one of the first intermediate partition plate and the second intermediate partition plate is composed of a pair of plate elements divided along a radial direction of the rotating shaft, and the plate elements include bonding surfaces which are made to abut against each other and include first recess portions defining bearing holes which rotatably support the first intermediate shaft portion or the second intermediate shaft portion of the rotating shaft, and

the bonding surfaces of the plate elements are provided at locations deviating from a range of 50° to 150° in a rotation direction of the rotating shaft, using a direction of the vane as a reference point, as seen from an axial direction of the rotating shaft.

6. The rotary compressor of claim **5**, wherein

the bonding surfaces of the plate elements are composed of perpendicular surfaces along the axial direction of the rotating shaft, second recess portions are formed on the bonding surfaces of the plate elements, the second recess portions define a suction port which cooperate to lead a refrigerant to the cylinder chambers when the bonding surfaces are made to abut, and a connection pipe is press-fitted into the suction port.

7. A refrigeration cycle apparatus comprising:

a circulation circuit having a refrigerant circulated and being connected to a radiator, an expansion device, and a heat absorber; and

the rotary compressor of any one of claims **1** to **6** connected to the circulation circuit between the radiator and the heat absorber.

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